Institute of Geology and Oil and Gas Engineering named after K.Turysov
Department of "Geophysics and Seismology"

EDUCATIONAL PROGRAM

7M07148 – «Engineering Geophysics»

Code and classification of the field of education: **7M07 "Engineering, manufacturing and construction industries"**

Code and classification of training directions: **7M071 "Engineering and Engineering affairs"**

Group of educational programs: **M109 "Petroleum and ore Geophysics"**

Level based on NQF: 7
Level based on IQF: 7
Duration of study: 1 year
Volume of credits: 60

Almaty 2025

The educational program 7M07148 – "Engineering Geophysics" was approved at the meeting of the Scientific Council of the National Academy of Sciences of KazNTU named after K.I.Satpayev.

Protocol № 9, «20» February 2025 y.

Reviewed and recommended for approval at the meeting of the Educational and Methodological Council of the National Academy of Sciences of Kazntu named after K.I.Satpayev.

Protocol № 4, «3» February 2025 y.

The educational program 7M07148 – "Engineering Geophysics" was developed by the academic committee in the field of training: 7M071 - "Engineering and Engineering affairs"

Full name	**Academic degree/ academic title**	**Position**	**Workplace**	**Signature**
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Teaching staff:				
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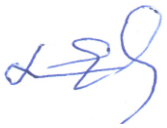
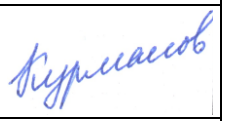
Khitrov Dmitry Mikhailovich	Candidate of Technical Sciences	Manager of the company's data processing center	«PGS Kazakhstan LLP»	
Kurmanov Baurzhan Koptleuovich	Master of Technical Sciences	General manager	OPTIMUM Design Institute LLP	
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List of abbreviations and designations

NAO KazNTU named after K.I.Satpayev - NJSC Kazakh National Research Technical University named after K.I.Satpayev;
GOSO – The State mandatory standard of education of the Republic of Kazakhstan;
Ministry of Education and Science of the Republic of Kazakhstan – Ministry of Science and Higher Education of the Republic of Kazakhstan;
OP – educational program;
University – higher education institution;
NQF – National Qualifications Framework;
Research and development–scientific and research work;
O – universal, socio-ethical competencies
IQF – Industry Qualifications Framework;
PC – professional competencies;
Teaching staff – teaching staff;
Russian Academy of Sciences – Republican Academy of Sciences of the Russian Federation;
LO – learning outcomes of the educational program;
C – special and managerial competencies.
JSC – joint stock company;
LLP - is a limited liability partnership.
CO - competence training;
SRO (SRS, SRM, SRD) – independent work of the student;
SROP (SRSP, SRMP, SRDP) – independent work of a student with a teacher;
RUP – working curriculum
IUP – individual curriculum
DB-basic discipline;
PD - is a profiling discipline;
UC - University component;
CC - Component of choice;
FC - final certification.

1. Description of the educational program

The Department of Geophysics and Seismology carries out educational activities in the direction of training along the trajectory of the specialized master's degree 7M07148 - "Engineering Geophysics".

The educational program of the specialized master's degree 7M07148 - "Engineering Geophysics" was developed within the framework of the direction - "Environment" and is aimed at obtaining knowledge and professional training of workers in the production sector in the application of modern geophysical methods for solving engineering and construction, engineering and geological and environmental problems. The specialized master's degree (1 year) provides in-depth professional training, and the training is of an applied nature.

It is aimed at developing not only management skills in all areas of geophysical activity, but also at training professional qualified managers and executives with competencies for new markets in the geological exploration industry, capable of solving complex geological and geophysical issues, including adaptation to climate change, development of innovative solutions and technologies to reduce environmental impact, and energy efficiency.

Today, due to the intensive growth of the economy of the Republic of Kazakhstan and especially the powerful development of the construction industry of rapidly developing cities, mining, irrigation and drainage and environmental industries of the Republic of Kazakhstan, the issue of training specialists in a narrow specialization of engineering and technical workers in the field of construction, hydrogeology, engineering geology and ecology is acute. The section of applied geophysics "Engineering Geophysics" is usually included in the curricula of universities and technical universities, on the general course "Applied Geophysics", training engineers of a general direction, including prospecting, exploration and production of minerals, engineering and construction, marine, environmental geophysics. For the correct orientation of future specialists in the field of geophysical research methods for solving engineering problems, it is important to conduct training in the subject "Engineering Geophysics" from a unified methodological position. These circumstances formed the basis for the development of the educational program 7M07148 - "Engineering Geophysics". The educational program was developed on the basis of generalization and systematization of extensive experience in the application of geophysical research methods in the study of the upper part of the lithospheric space as a human habitat and its changes under the influence of anthropogenic factors.

The program is aimed at training graduate students of universities and technical schools in the specialties of "engineering geology, hydrogeology and ecology". Many of its sections will allow geophysicists, hydromeliorators and builders, ecologists, specialists engaged in scientific and practical activities related to the design and construction of various engineering structures, their operation, drainage and land reclamation, environmental protection issues to deepen their knowledge.

The specialized master's program "Engineering Geophysics" is designed to train highly qualified specialists in the field of geophysical research and technology.

The main focus is on the application of geophysical methods to solve problems in the field of subsoil use, construction, ecology and environmental protection.

The training includes an in-depth study of physical processes occurring in the earth's crust and methods of their study using geophysical instruments, using modern innovative technologies such as processing and analysis of big data, the use of geographic information systems (GIS) and modeling of geophysical processes. The training includes elements of related sciences - geology, engineering, ecology and computer science.

The program includes the study of methods for the sustainable use of natural resources and minimization of negative impacts on the environment (SDG 12), provides training in methods for monitoring and assessing groundwater, as well as identifying pollution (SDG 6), and is based on the study of geophysical methods for assessing and monitoring the state of urban infrastructure (SDG 11).

The programme involves collaboration with various organisations and enterprises in the field of science and technology (SDG 17) and ensures that learning materials and learning environments are accessible to students with different abilities, including those with physical or sensory limitations. The programme is designed in such a way that students from different socio-economic and cultural backgrounds have equal opportunities for learning and professional development, which facilitates the exchange of experiences and ideas.

The educational program includes elements of teamwork, which helps develop communication and interaction skills in a multinational and multifunctional environment.

The program is aimed at training university and technical college master's students specializing in engineering geology, hydrogeology and ecology. Many of its sections will provide in-depth knowledge to geophysicists, hydromeliorators and builders, ecologists, specialists engaged in scientific and practical activities related to the design and construction of various engineering structures, their operation, drainage and land reclamation, and environmental protection issues.

The specialized master's program (1 year) in the direction 7M07148 - "Engineering Geophysics" provides in-depth training of specialists, covering the following sections: geological and geophysical substantiation of the use of physical fields to solve the assigned problems; theoretical physical and mathematical foundations of applied geophysical methods; specialized methods and modifications of geophysical research, features of registration, processing and analysis of geophysical signals in near-surface conditions; application of modern geoinformation systems and machine learning algorithms for modeling the geological and mining environment; planning and control of the development and operation of engineering and construction surface and underground structures. Master's students will gain knowledge on the features of the application of innovative geophysical methods in hydrogeology, soil science, engineering and mining geology, permafrost science, glaciology, technical geology, archeology, etc.

Highly qualified university lecturers, professors from leading universities in the near and far abroad, specialists from manufacturing enterprises and research institutes are invited to give lectures and provide consultations on modern problems

of engineering geophysics.

The program involves master's students gaining both theoretical knowledge in lectures and participating in practical work. Master's students will have the opportunity to participate in field work and at production facilities, in scientific and experimental research and internships in leading geological, geophysical and manufacturing companies.

The training includes theoretical classes, practical work and participation in research projects, which will ensure the successful application of the acquired knowledge in the professional activities of the master's student. Graduates will be prepared for professional activities in both the production and scientific spheres, and will also be able to continue their educational trajectory in doctoral studies.

Master's students will be able to complete their internship in research institutions: Institute of Geophysics of the Ministry of Education and Science of the Republic of Kazakhstan, Institute of Geological Sciences named after K. I. Satpayev; construction and production service geological-geophysical and gyrogeological companies: PGS, "SPC" Geoken ", "Geo Energi Group", "TatArka", "Kazakh Geophysical Company", "Batys Geofizservis", "GIS Company", "Azimut Energy Services", "Kazakhmys", LLP "Alstron", LLP "Azimut Geology", LLP "Anega Kazakhstan", JSC "Volgovgeologiya" - "Geotechnocenter", LLP "GIS", LLP "DP Ortalyk", LLP "Zhanros Drilling", LLP "Izdenis", LLP "KazGIIZ", LLP SP "KATKO", LLP "Bapy Mining", JSC "NAC KazAtomProm" "KAZ MineralsPLS", JSC "MMC Kazakhaltyn", LLP "GEO ENERGY GROUP", construction companies corporation "Bazis-A", Rams Kazakhstan LLP, etc.

The best master's students can receive additional education under the academic mobility program at the Colorado School of Mines (USA), Moscow State University, Tomsk Polytechnic University, Freihe University, Lorraine University (Nancy, France), Institute of Mining Engineering and Technology (Beijing, China), Adam Mickiewicz University (Poland), University of Warsaw (Poland), Bergakademie Freiberg (Germany), Vrije Universiteit Brussel (Belgium), Natural History Museum (London, UK) and other universities.

Graduates receive a Master of Engineering and Technology qualification and work in construction, engineering-geological and mining companies, in engineering positions, and as research fellows in research institutes.

The demand for a profession in the specialty of geophysics is high and has many positive aspects:

1. High demand for specialists and a variety of career opportunities, as geophysics is a key area for mining, energy and the environment, which creates a strong demand for skilled production workers;

2. Innovative technologies: work in geophysics often involves the use of modern technologies and methods, such as seismic exploration, ground-penetrating radar systems and computer modeling, making the profession interesting and dynamic.

3. Contribution to sustainable development: geophysicists play an important role in assessing and minimizing environmental impacts, which contributes to

sustainable development and nature conservation.

4. Interdisciplinary approach: geophysics combines elements of physics, mathematics, geology and engineering, allowing specialists to develop a wide range of skills and knowledge.

5. International career opportunities: geophysicists can work in different countries and regions, which opens up opportunities for travel and cultural exchange.

6. Competitive Salary: Geoscience engineering professionals earn high salaries, especially in the construction and mining sectors, when working for international companies.

These aspects make the geoscience profession attractive to many students and professionals.

Field of professional activity:

The geological environment is the object of direct research of various scientific and applied geological disciplines. Geophysics provides additional indirect information, and solves individual problems independently. The greatest information content and economic efficiency are achieved by combining geological and geophysical methods

Professional activity of masters can be carried out in academic and departmental research organizations related to solving engineering-geological and mining problems; industrial geological organizations, firms and companies carrying out engineering and construction activities, hydrogeological research, companies monitoring the operation of engineering facilities, environmental protection and engaged in solving environmental problems.

Objects of professional activity:

The geological environment, surface and underground structures are studied by shallow geophysical methods to solve a wide range of problems in construction, hydrogeology, soil science, engineering and mining geology, permafrost science, glaciology, technical geology, archeology, etc. Here, the features of the geological and geophysical environment with a thickness of hundreds of meters are studied, and especially the upper part of the section (UPS) with a thickness of tens of meters. In the upper shell of the earth's crust, called the biotechnosphere, or exotechnosphere, natural, exogenous geological, biological and anthropogenic-technogenic processes are manifested to the greatest extent, since here soils, grounds, rocks are affected by external, exogenous (air and water) and deep (pressure, temperature, gravity) processes, natural and artificial physical fields influence, biological activity and anthropogenic (engineering and economic) human activity are manifested. The program includes acquiring knowledge and practical skills for professional activities based on the use of modern geophysical research technology: seismic, gravimetric, magnetometric, electrical tomography, electromagnetic survey, logging, vertical electrical sounding, studying the characteristics of acoustic fields, radio wave scanning.

The subjects of professional activity are:

- Geological and geophysical environment characterized by heterogeneity in space in lithology and physical properties of rocks, soils and grounds.

- Nonlinearity of changes in the properties of the environment is studied, which manifests itself as the interdependence of the parameters of physical fields, strain sensitivity, i.e. the dependence of the elastic parameters of rocks on pressure, fluid sensitivity, i.e. changes in elastic, electromagnetic and other parameters depending on the geochemical composition of the solid phase of rocks and the composition of fluids (water, oil, gas), their movement; inadequate response of the environment to external influences.

- The geological and geophysical environment is affected by temporal variations in cosmic fields, which are rhythmic (ordered) or chaotic (random), as well as increasing intensity of man-made physical fields.

Geophysical methods used to study the geological environment are subject to specific requirements:

• ensuring high detail at relatively shallow depths of study of the environment;

• using mobile shallow methods and lightweight measuring units to speed up and reduce the cost of geophysical work and the possibility of conducting repeated observations (field monitoring);

• using a set of geophysical methods of various physical natures to improve the accuracy of the information obtained;

• widespread use of boreholes and mine workings, the excavation of which is not difficult at shallow exploration depths.

The areas of professional activity of the Master in the profile direction are:

- organizational and technological; calculation and design; service and operational; production and technological activities in:

- The Ministry of Energy and the Ministry of Industry and Infrastructure Development of the Republic of Kazakhstan;

- academic and departmental research organizations related to solving geological problems;

- operator and service companies conducting geological exploration work on prospecting, exploration and further exploration of mineral deposits, as well as monitoring the development of these deposits;

- organizations related to environmental monitoring and solving environmental problems.

Types of professional activity:

Masters in the field of training "Engineering Geophysics" are preparing to implement scientific research and scientific production professional activities. In accordance with the theoretical and professional training received, they can perform the following types of activities:

a) organizational and managerial activities:

- planning, organization and management of scientific research and scientific production field, laboratory and interpretation geological and geophysical works;

- development of operational plans for the work of geophysical parties and

teams;

- selection and justification of scientific, technical and organizational solutions based on geological and geophysical data and economic calculations.
- planning and organization of scientific and scientific production seminars and conferences.

b) research activities:

- independent selection and justification of the goals and objectives of geological and geophysical scientific research;
- independent selection and mastering of methods for solving the assigned tasks during field, laboratory, interpretation work using modern geophysical equipment, digital instruments and information technologies;
- analysis and generalization of the results of research works using modern achievements of science and technology, advanced domestic and foreign experience in the field of geophysics and geology;
- evaluation of the results of research geophysical work, preparation of scientific reports, publications, reports, drafting applications for inventions and discoveries.

c) research and production activities:

- independent preparation and implementation of production and research and production, field, laboratory and interpretation work in solving practical geological and geophysical problems;
- independent selection, preparation and professional operation of digital geophysical field and laboratory equipment and instruments;
- collection, analysis and systematization of a priori geological and geophysical information using modern information technologies;
- complex digital processing, interpretation and modeling of field and laboratory information in order to solve scientific and industrial geological and geophysical problems;
- determination of the economic efficiency of scientific and industrial geological and geophysical research;
- participation in the development of regulatory and methodological documents in the field of geological and geophysical work.

d) project activities:

- design and implementation of scientific and technical projects in geology and geophysics;
- design of works in the field of rational subsoil use and protection of the geological environment;
- participation in the examination of projects of scientific research geological and geophysical works.

2. The purpose and objectives of the educational program

The goals and objectives of the presented educational program are formulated taking into account the requirements and requests of potential consumers, as well as based on an assessment of the demand for this educational program, which is determined by the interests of potential employers, students, the potential of the

university, the requirements of the state in the field of sustainable development and society as a whole.

Purpose of EP: Training of highly qualified specialists with modern knowledge and skills in the field of geophysical research and technologies, capable of effectively solving problems related to subsoil use, engineering surveys, environmental protection and sustainable development using the skills of planning, organizing and managing work based on inclusion and gender equality

Tasks of EP:

- obtaining the foundation of professional education based on general technical and managerial knowledge of the cycle of basic disciplines based on compliance with all principles of inclusive education; providing master's students with deep knowledge in the field of related sciences and geology, necessary for understanding geophysical processes;
- study of the cycle of specialized disciplines focused on key theoretical and practical aspects of engineering geophysics and technology of conducting geophysical research, taking into account the reduction of the level of man-made loads in the conditions of geophysical activity;
- training of master's students in methods of collecting a priori information for design, organization and management of field and office geophysical work in the sustainable solution the assigned tasks;
- training master's students in methods of organizing, managing and conducting field engineering and geophysical research through the introduction of innovative technologies with the aim of reducing the impact on the environment, gender equality and the principles of the SDGs (SDGs 4-9, 13);
- training in conducting field research and office data processing; auxiliary operations for checking, calibrating and adjusting geophysical equipment taking into account the specifics of digital registration of geophysical fields, as well as conducting field and office data processing;
- acquiring skills in general technical and administrative management and ensuring the timely execution of interpretation of geophysical materials based on the use of innovative digital interpretation systems
- acquiring skills in compliance with occupational health and safety, environmental protection, and fire safety requirements when conducting geophysical surveys, introducing knowledge and skills in the field of environmental responsibility, social sustainability, and effective project management (SDG 4, SDG 12, SDG 13, SDG 15);
- development of practical skills and competencies for the implementation of engineering solutions that contribute to the achievement of the SDGs (SDG 7, SDG 8, SDG 9);
- obtaining skills in compliance with labor protection, safety and environmental protection requirements, as well as fire safety when conducting geophysical research;
- familiarization with the methods, technologies and equipment of state, operator and service departments and companies during the period of scientific research internships.

- Implementation of knowledge and skills in the field of environmental responsibility, social sustainability and effective project management;
- Development of practical skills and competencies for the implementation of engineering solutions that contribute to the achievement of the SDGs;
- to develop in master's students an understanding of the principles of sustainable development and environmental responsibility in their professional activities;
- to teach students to work in interdisciplinary teams, interact with representatives of various fields (geology, ecology, engineering, etc.) to solve complex problems;
- to create conditions for the training of all students, regardless of their individual characteristics, and to develop skills for working in a multinational and multifunctional environment;
- to provide master's students with opportunities for practical training and internships at enterprises and organizations engaged in geophysical research, which will allow them to gain real experience in the profession.

These tasks are aimed at developing the necessary competencies and skills in students that will enable them to work successfully in the dynamically developing field of engineering geophysics and contribute to the sustainable development of society.

3. Requirements for evaluating the educational program learning outcomes

A graduate of the educational program for the specialized master's degree is awarded the academic degree of Master of Engineering and Technology.

A graduate of the Department of Geophysics and Seismology under the educational program for the specialized master's degree must know:

- the goals and objectives of engineering geophysics in the system of Earth sciences;
- be aware of the social significance of their future profession;
- be highly motivated to perform professional activities;
- be able to assess the capabilities of geophysical methods and navigate the conditions of applicability of geophysical surveys;
- have skills in working with geophysical equipment and geophysical data, as well as have skills in working with a computer as a means of managing digital information.
- as part of a research team, demonstrate the ability to manage, design and conduct geophysical research, participate in the preparation of projects, reports, abstracts, bibliographies on the topic of scientific research, in the preparation of publications;
- demonstrate skills in working with field and laboratory geophysical instruments, installations and equipment.
- apply in practice methods of collecting, processing, analyzing and summarizing stock, field and laboratory geological and geophysical information; participate in the organization of scientific and scientific-practical seminars and

conferences.

The volume of the educational program (EP) of the master's degree is 60 credits, regardless of the form of training, applied educational technologies.

The content of the EP "Engineering Geophysics" is formed on the basis of the development of a multi-level system of personnel training, fundamentality and quality of training, continuity and succession of education and science, the unity of training, education, research and innovation activities, aimed at maximum satisfaction of consumer needs and should ensure:

- obtaining a full and high-quality theoretical and professional education in the field of geophysics, confirmed by the level of knowledge and skills, abilities and competencies, based on the criteria established by the State General Education Standard, their assessment, both in content and in volume;
- training of masters for the geophysical industry, knowledgeable in the technology and methods of conducting geophysical research, digital methods of processing, interpretation and modeling of the obtained data, ready to be managers and leaders in production projects based on the skills and knowledge necessary to promote sustainable development, including through training on sustainable development, human rights, gender equality;
- application of knowledge of fundamental and technical sciences, including geology, tectonics and theoretical and applied foundations of geophysical methods;
- use of methods of system analysis, when assessing the obtained geophysical data;
- knowledge of modern problems of geophysics;
- acquisition of practical skills in working with digital geophysical equipment, modern software for processing, interpreting and modeling the obtained geophysical data using modern information and digital technologies to obtain sustainable results;
- use of methods, skills and modern technical means necessary for the study of physical processes in the upper earth and mine workings based on responsible consumption and production, conservation of terrestrial and marine ecosystems (SDG 12, SDG 15);
- the ability to work with necessary, up-to-date literature, computer information, databases and other sources of information for a sustainable solution to the tasks set;
- development of production and ethical responsibility in master's degree students, the ability to understand the problem from joint work with various specialists, to find optimal solutions, the need to improve their knowledge and skills; developing in master's students industrial and ethical responsibility, the ability to understand the problem from joint work with various specialists, find optimal solutions, the need to improve their knowledge and skills, demonstrate partnership skills for the purpose of sustainable development (SDG 15)
- readiness of master's degree students for professional activity through disciplines that provide in-depth professional knowledge, skills and abilities to work in production, government organizations and services, research institutes and educational institutions;
- have erudition, knowledge of modern social and political problems, be

proficient in the state, Russian and foreign languages, market economy instruments, safety and environmental protection issues.

- to perceive social, ethnic, religious and cultural differences in a tolerant manner, to appreciate the traditions of other cultures, their diversity in modern society, fundamental basic education, economic, social and legal training;
- be capable of self-criticism and criticism, possess collaboration and interaction skills, and be ready to assume the role of a team leader.
- maintain the rules of ethics in society, at work and in interpersonal communication, demonstrate the ability to achieve goals, solve problems in non-standard situations.
- to take care of environmental protection and, by improving skills, to serve the development of the welfare of the whole society.

Expected results:

After completing the program, master's students will be able to:

- Conduct geophysical research using modern methods and technologies;
- Analyze and interpret geophysical data to solve practical problems;
- Work in interdisciplinary teams and effectively interact with colleagues from various fields;
- Apply the principles of sustainable development in their professional activities.

This master's program is aimed at training specialists who are ready for the challenges of the modern world and are able to contribute to the sustainable development of society.

4. Passport of the educational program

4.1. General information

Table 1- Educational program passport

№	Field name	Comments
1	Code and classification of the field of education	7M07 "Engineering, manufacturing and construction industries"
2	The code and classification of training directions	7M071 "Engineering and Engineering affairs "
3	Educational program group	M109 "Petroleum and ore Geophysics"
4	Educational program name	7M07148 – " Engineering Geophysics "
5	Brief description of the educational program	The specialized master's program (1 year) in the direction 7M - "Engineering Geophysics" provides in-depth training of specialists in the field of physical and geological foundations of geophysical methods for solving a wide range of problems in the construction of surface and underground structures, hydrogeology, soil science, engineering geology, permafrost, glaciology, technical geology, archeology, etc., including obtaining by master's students high-quality knowledge on: - theoretical foundations and physical and geological conditions for the application of geophysical research; - features of the methodology and technology of field work in the study of the geological structure of the upper part of the section; - survey of surface and underground engineering structures; modern recording and processing hardware and methodological geophysical complexes; - digital processing, analysis of physical fields, modeling of geophysical processes and geological interpretation of geophysical data using modern digital software; - acquisition by students of a set of knowledge on the use of geographic information systems (GIS) for visualization, integration of geophysical data with other geoscientific data and analysis of the results obtained.
6	The purpose of the educational program	Training of highly qualified specialists with modern knowledge and skills in the field of geophysical research and technologies, capable of effectively solving problems related to subsoil use, engineering surveys, environmental protection and sustainable development using the skills of planning, organizing and managing work based on inclusion and gender equality
7	Type of educational program	New
8	The level based on NQF	7
9	The level based on IQF	7
10	Distinctive features of EP	no
11	List of competencies of the educational program:	**General cultural competencies (GC):** GC-1 Ability to communicate orally and in writing in the state, Russian and foreign languages to solve problems of interpersonal and intercultural interaction; GC-2 Ability to critically use methods of modern science in practical activities GC-3 Awareness of the need and acquisition of the ability to independently learn and improve one's qualifications throughout one's working life

		GC-4 The importance and understanding of professional ethical standards, mastery of professional communication techniques GC-5 Ability to work in a team, tolerantly perceiving social, ethical, religious and cultural differences GC-6 Ability to use the basics of economic knowledge in various fields of activity. **General professional competencies (GPC):** GPC-1 Ability to independently acquire new knowledge using modern educational and information technologies GPC-2 Possession of computer skills and knowledge of professional programs sufficient for professional activity GPC-3 Knowledge of basic methods, ways and means of obtaining, storing, processing information, ability to use modern digital technical means and information technologies to solve professional problems GPC-4 Understanding the essence and knowledge of information in the development of modern society, ability to receive and process information from various sources, readiness to interpret, structure and present information in a form accessible to others. **Professional competencies (PC):** PC 1 Ability to systematically study scientific and technical information, domestic and foreign experience in the geophysical profile of training PC 2 Ability to integrate applied sections of geophysics and specialized geological and geophysical knowledge (including physical processes occurring in the Earth) to solve production problems of geology and geophysics; PC 3 Ability to participate in work on innovative projects, using in-depth research methods. Possession of skills of systemic logical thinking in the analysis of scientific data and setting practical problems of geophysical research; PC 4 Ability to generalize geological and geophysical information to select the main parameters of field geophysical survey, to manage, design and conduct experimental and methodological work and optimize the methodology of geophysical observations; PC 5 Ability to independently set specific geophysical problems and solve them using modern digital equipment, innovative software and information technologies using the latest domestic and foreign experience; PC 6 Ability to manage research and production work in solving complex geophysical problems, at the stages of design, execution (including processing, analysis and interpretation) and preparation of reports for presentation of results; PC 7 Possession of skills in professional operation of modern geophysical field equipment; determination of technical and technological parameters of equipment, equipment, materials and preparation of equipment for field work (adjustment, verification or testing, preventive maintenance); PC 8 Availability of skills in organizing and conducting geophysical observations and primary processing of recorded data; PC 9 Ability to carry out metrological measures to prepare

		equipment, tools and installations with an acceptable error. Calibration and standardization of geophysical equipment 12designed to solve geophysical problems. Skills in organizing and conducting high-quality digital processing for linking and joint geological interpretation of the results of previous stages of processing geophysical and petrophysical data. Organization of the execution of processing results and their transfer to the customer; PC 10 Proficiency in digital software packages for computers designed to work with a set of geophysical data; PC 11 Ability to analyze and apply in work the laws on subsoil and subsoil use, industrial safety and environmental code, state geophysical expertise, regularly monitor changes and additions to these legal norms and laws; PC 12 Ability to highlight and systematize the main ideas in scientific publications; critically evaluate the effectiveness of various approaches to solving geophysical problems; formulate an independent view on the proposed problem, taking into account the latest domestic and foreign experience and knowledge of the main directions of development and problems of geophysics, the current level of elaboration of problems and the most promising areas of development.
12	**Learning Outcomes (LO) for the educational program:**	LO1. Demonstrate knowledge of key physical principles and methods used in engineering geophysics, determine their application to solving practical problems in the field of subsoil use, construction and environmental protection LO2. To present innovative methods of engineering geophysics in accordance with the requirements of professional standards in the field of solving problems in subsoil use, construction and environmental protection, to professionally use methods of collecting a priori information for designing field studies, to develop and propose sustainable and environmentally friendly solutions for solving problems related to engineering geophysics research in accordance with the principles of sustainable development LO3. Apply skills in preparing geophysical equipment for work, managing engineering measurements and creating the most optimal conditions for organizing work based on the principles of competent management and management psychology LO4. Analyze and interpret engineering geophysical data using modern software tools and evaluate the quality of data and research results using innovative technologies and artificial intelligence LO5. Integrate knowledge from various fields (mathematics, computer science, geology and geophysics) to solve problems in a comprehensive manner based on professional and ethical standards in the field of engineering geophysics, including assessing the consequences of their activities and respecting the rights and interests of all participants in the process LO6. Conduct professional scientific activities in an international environment, publish in highly rated journals and participate in international research projects LO7. Assess the economic and environmental performance of engineering geophysical projects taking into account international ESG standards

13	The form of education	full-time
14	Duration of training	1
15	Volume of loans	60
16	Languages of instruction	Russian/Kazakh
17	Academic degree awarded	Master of Engineering and Technology
18	Developer(s) and authors:	1) Professor Istekova S.A., 2) Associate Professor Umirova G.K., 3) senior teacher Tolybaeva D.N., 4) lecturer Muzapparova A. B.

4.2. The relationship between the achievability of the formed learning outcomes in the educational program and academic disciplines

Table 3 – Results of training in the educational program "Digital (exploration) Geophysics"

№	Name of the discipline	Brief description of the discipline	Amount of credits	Generated learning outcomes (codes)						
				PO1	PO2	PO3	PO4	PO5	PO6	PO7
CYCLE OF BASIC DISCIPLINES (BD)										
M-1. Module of basic training (university component)										
1	Foreign language (professional)	The purpose of the discipline is to acquire and improve competencies in accordance with trade standards of foreign education, capable of competing in the labor market, because through a foreign language, the future master gains access to academic knowledge, new technologies and modern information, allowing the use of a foreign language as a means of communication in the intercultural, professional and scientific activities of the future master.	2						v	
2	Management	To form a scientific understanding of management as a type of professional activity. Contents: Mastering the general theoretical principles of managing socio-economic systems; acquiring skills and abilities in practical problem-solving of managerial issues; studying global management practices and the specificities of Kazakhstani management; training in solving practical issues related to managing various aspects of organizational activities.	2							v
3	Psychology of Management	To acquire skills in making strategic and managerial decisions, taking into account the psychological characteristics of the individual and the team. Content: the modern role and content of psychological aspects in management activities, methods for improving psychological literacy, the composition and structure of management activities, both at the local and foreign levels, the psychological feature of modern managers.	2			v				
Component of choice										
4	Applied Geophysical Methods in Engineering and Geological Surveys	Objective: study of engineering geophysics methods for studying the geological environment using shallow geophysical methods in order to solve engineering geological and geophysical problems. Contents: Basic geophysical methods in engineering geological surveys. Operating principles, field methods, data processing and interpretation; selection of optimal methods for soil assessment,	4	v	v			v		

		detection of voids, tectonic faults and engineering hazardous processes. Integration of geophysical methods with geological, geochemical and other methods. Integrated interpretation of geophysical data based on pattern recognition algorithms								
5	Petrophysical Fundamentals of Engineering and Mining Geophysics	Objective: To form stable, inclusive knowledge about the physical properties of rocks, about the patterns of their changes in the upper part of the geological section. Content: Petrophysics as a basis for interpretation of engineering geophysics data. Chemical composition and structure of rocks. Patterns of distribution of magnetic properties, density, elastic and electromagnetic parameters. Petrophysical connections for the integrated application of geophysics in determining engineering and geological parameters. The use of digital and adaptive technologies to study petrophysical parameters. Sustainable petrophysical monitoring and forecasting of geological processes.	**4**	**v**	**v**			**v**		
CYCLE OF PROFILE DISCIPLINES (PD)										
M-2. Module of professional activity (university component, component of choice)										
6	Near-Surface Geophysical Methods in Engineering and Geological Surveys	Objective: To provide inclusive and sustainable education for the formation of knowledge about the geophysical methods of studying the upper part of the section to solve engineering and hydrogeological problems. Contents: Parameters, properties and conditions of rocks. Predictive and preventive measures of geodynamic phenomena. Methods of observing the environment. Technique and methodology of geophysical methods. Small-depth modifications. Georadar research for surface, underground and borehole operations. Interpretation of seismic, gravimetric, electromagnetic, and nuclear-geophysical data. The use of digital educational technologies in obtaining sustainable engineering solutions to engineering and geological problems.	**5**	**v**	**v**		**v**	**v**		
7	Techniques and Methods of Geophysical Operations in Mining and Underground Structures	Objective: Formation of stable knowledge on the technique and methodology of geophysical work in difficult mining and geological conditions based on the principles of inclusion Contents: Methods and technologies of geophysical research used in the design, construction and operation of mining and underground structures. Methods for detecting geological disturbances, determining the physical and mechanical properties of rocks and monitoring the condition of massifs to ensure the safety and	**5**	**v**	**v**	**v**	**v**		**v**	

		effectiveness of engineering work using digital technologies to improve the accuracy and efficiency of engineering work.								
8	Geophysical methods in the construction of engineering utility	Objective: To study the methods of geophysics in the construction of engineering buildings based on the use of sustainable and inclusive technologies Contents: The reaction of the geological environment to changes related to construction. Principles of minimizing environmental impact and using energy-efficient technologies. Methods for assessing the stress state of the geological environment. Geophysical methods for different types of objects. Theory and possibilities of seismic, electrical exploration, gravimagnetic methods, radiometry for obtaining sustainable solutions based on the principles of inclusion.	**5**	**v**	**v**	**v**				
9	Methods of environmental geophysics	Objective: To study geophysical methods for solving issues of protecting the geological environment in order to make sustainable and environmentally sound decisions in engineering geophysics Content. Zoning of territories, a sign of the sensitivity of rocks to various types of pollution. Foci of pollution and the definition of the boundaries of its spread. Quantitative indicators, the degree of environmental pollution impact. Assessment of pollution development over time. Forecasting the impact of anthropogenic activities on ecosystems. Innovative technologies in the field of environmental responsibility. Techniques and technologies of ecological geophysics methods	**5**	**v**	**v**					**v**
10	Monitoring of Completed Structures Using Geophysical Methods	Objective: Formation of knowledge on geophysics to control the safe operation of completed engineering structures based on the principles of inclusion with an emphasis on sustainable infrastructure development Contents: The physical foundations, technique and technology of geophysical methods (electrical exploration, seismic exploration, GPR, etc.) used to monitor the technical condition of completed structures. Principles of monitoring, interpretation of data, identification of defects, deformations and other changes in the structure of completed structures. Practical aspects of the application of methods at industrial facilities.	**5**	**v**	**v**	**v**		**v**		
11	Geophysical Methods for Monitoring the Operation of Engineering Structures	Objective: To study geophysical methods in solving the problems of geotechnical monitoring of engineering structures for the stability and safety of infrastructure based on inclusive education.	**5**	**v**	**v**	**v**				

		Contents: Monitoring of infrastructure with limited direct measurement methods of controlled parameters. Seismic and gravimetric methods, methods of electromagnetic surveys for monitoring the technical condition of structures. Processing and interpretation of geophysical observations. Man-made and natural factors of changes in the condition of building structures, methods of their assessment. Creation of safe and sustainable engineering solutions that take into account socio-environmental factors.								
12	Surface and Subsurface Mine Geophysical Methods	Objective: To study surface-underground mining and geophysical methods in ore deposits with the formation of skills in working with modern software Contents: Theoretical and practical aspects of surface-underground geophysical methods: magnetometry, electrometry, seismic exploration, thermometry. Stations, mine seismometers, and ground-penetrating radars. Features of geophysics in underground conditions, methods of data interpretation, assessment of geological and engineering risks, identification of danger zones (collapses, gas saturation, etc.). Software for geophysical data: Surfer, Oasis montaj, RadExPro, Zond. Specialized 3D modeling modules for mining conditions.	**5**	**v**	**v**			**v**		
13	Techniques and methods of subsurface geophysical operations	Objective: To study the principles of organization, techniques and methods of conducting geophysical research in underground conditions to solve the problems of engineering geophysics. Contents: Theoretical foundations, technique and technology of performing geophysics in underground workings. The specifics of the operation of geophysical equipment, methods of laying observation networks, measurement techniques, safety requirements in difficult mining and geological conditions. Methods of data interpretation. Examples of the application of geophysics methods for monitoring the condition of the massif, assessing the stability of mining workings and forecasting mining and geological hazards.	**5**	**v**	**v**	**v**				
14	Digital measuring and processing systems	Purpose: To gain knowledge about the design and functioning of digital hardware and methodological complexes in engineering geophysics. Contents: Scientific and technical fundamentals of the use of digital geophysical equipment and preparation for independent work. Theory of analog and digital registration of geophysical signals of	**4**			**v**	**v**			

		various types. The concept of information structure. The main characteristics of modern digital linear and telemetric recording and processing complexes; practical mastering of working techniques on modern digital computerized hardware and methodological complexes.								
15	Geological and geophysical modeling of underground structures	Objective: To study the basic methods of constructing a model of underground structures based on geological and geophysical research. Contents: The study of methods for constructing a model of an underground structure in the environment of modern geoinformation systems, taking into account the features of the geological structure and properties of mountain ranges, using geophysical methods. The main methodological techniques are the creation of a digital database of initial geological, geophysical and mining data, the use of mathematical methods, the use of modern specialized computer programs; integration of geological and geophysical data to build three-dimensional models of underground structures, structuring and visualization of the results.	**4**	**v**	**v**	**v**				

5. The curriculum of the educational program

NON-PROFIT JOINT STOCK COMPANY
"KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY NAMED AFTER K.I. SATBAYEV"

SATBAYEV UNIVERSITY

«APPROVED»
Decision of the Academic Council
NPJSC«KazNRTU
named after K.Satbayev»
dated 20.02.2025 Minutes № 9

WORKING CURRICULUM

Academic year	**2025-2026 (Autumn, Spring)**
Group of educational programs	**M109 - "Oil and ore geophysics"**
Educational program	**7M07148 - "Engineering Geophysics"**
The awarded academic degree	**Master of engineering and technology**
Form and duration of study	**full time (professional track) - 1 years**

Discipline code	Name of disciplines	Block	Cycle	Total ECTS credits	Total hours	lek/lab/pr Contact hours	in hours SIS (including TSIS)	Form of control	Allocation of face-to-face training based on courses and semesters		Prerequisites
									1 course		
									1 sem	2 sem	
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)											
CYCLE OF BASIC DISCIPLINES (BD)											
M-1. Module of basic training (university component)											
LNG212	Foreign language (professional)		BD, UC	2	60	0/0/30	30	E	2		
MNG726	Management		BD, UC	2	60	15/0/15	30	E	2		
HUM211	Psychology of management		BD, UC	2	60	15/0/15	30	E	2		
M-1.1 Component of choice											
GPH788	Applied Geophysical Methods in Engineering and Geological Surveys	1	BD, CCH	4	120	30/0/15	75	E	4		
GPH789	Petrophysical Fundamentals of Engineering and Mining Geophysics	1	BD, CCH	4	120	30/0/15	75	E	4		
CYCLE OF PROFILE DISCIPLINES (PD)											
M-2. Module of professional activity (component of choice)											
GPH790	Near-Surface Geophysical Methods in Engineering and Geological Surveys	1	PD, CCH	5	150	30/0/15	105	E	5		
GPH791	Techniques and Methods of Geophysical Operations in Mining and Underground Structures	1	PD, CCH	5	150	30/0/15	105	E	5		
GPH792	Geophysical Methods in the Construction of Engineering Structures	2	PD, CCH	5	150	30/0/15	105	E	5		
GPH793	Methods of environmental geophysics	2	PD, CCH	5	150	30/0/15	105	E	5		
GPH794	Monitoring of Completed Structures Using Geophysical Methods	3	PD, CCH	5	150	30/0/15	105	E	5		
GPH795	Geophysical Methods for Monitoring the Operation of Engineering Structures	3	PD, CCH	5	150	30/0/15	105	E	5		
GPH796	Surface and Subsurface Mine Geophysical Methods	4	PD, CCH	5	150	30/0/15	105	E	5		
GPH797	Techniques and methods of subsurface geophysical operations	4	PD, CCH	5	150	30/0/15	105	E	5		
GPH798	Digital measuring and processing systems	1	PD, CCH	4	120	30/0/15	75	E		4	
GPH799	Geological and geophysical modeling of underground structures	1	PD, CCH	4	120	30/0/15	75	E		4	
M-3. Practice-oriented module											
AAP253	Internship		PD, UC	5				R		5	
M-4. Experimental and research module											
AAP257	Experimental research work of a master student, including an internship and the implementation of a master's project		ERWMS	13				R		13	
M-5. Module of final attestation											
ECA213	Design and defense of the master's project		FA	8						8	
Total based on UNIVERSITY:									30	30	
									60		

Number of credits for the entire period of study

		Credits

Cycle code	Cycles of disciplines	Required component (RC)	University component (UC)	Component of choice (CCH)	Total
GED	Cycle of general education disciplines	0	0	0	0
BD	Cycle of basic disciplines	0	6	4	10
PD	Cycle of profile disciplines	0	5	24	29
Total for theoretical training:		**0**	**11**	**28**	**39**
RWMS	Research Work of Master's Student				0
ERWMS	Experimental Research Work of Master's Student				13
FA	Final attestation				8
TOTAL:					**60**

Decision of the Educational and Methodological Council of KazNRTU named after K.Satpayev. Minutes № 4 dated 03.02.2025

Decision of the Academic Council of the Institute. Minutes № 5 dated 28.01.2025

Signed:	
Governing Board member - Vice-Rector for Academic Affairs	Uskenbayeva R. K.
Approved:	
Vice Provost on academic development	Kalpeyeva Z. Б.
Head of Department - Department of Educational Program Management and Academic-Methodological Work	Zhumagaliyeva A. S.
Director - Geology and Oil-gas Business Institute named after K. Turyssov	Auyelkhan Y. .
Department Chair - Geophysics and seismology	Ratov B. T.
Representative of the Academic Committee from Employers ___Acknowledged___	Khitrov D. M.